

### **REMARKS**

In the Office Action, the Examiner objected to the drawings and rejected claims 1-10 and 26-35. By this paper, Applicant has amended FIG. 4 and claims 1, 4, 6, 9, 26, and 32. The amendments do not add any new matter. In view of the forgoing amendments and the following remarks, the Applicant respectfully requests reconsideration and allowance of all pending claims.

#### **Objection to the Drawings**

In the Office Action, the Examiner objected to the drawings based on M.P.E.P. § 608.02(g). In particular, the Examiner stated that:

Figure 4 should be designated by a legend such as --Prior Art-- because only that which is old is illustrated. See MPEP § 608.02(g). Corrected drawings in compliance with 37 CFR 1.121(d) are required in reply to the Office action to avoid abandonment of the application.

Office Action, page 2, lines 12-15.

Applicant has amended FIG. 4 to denote "Prior Art," as suggested by the Examiner. In light of this amendment, the Applicant respectfully requests that the Examiner withdraw the objection to the drawings.

#### **Claim Rejections under 35 U.S.C. § 102**

In the Office Action, the Examiner rejected claims 1-5 and 26-35 under U.S.C. § 102(b) as anticipated by Chen et al. (U.S. Patent No. 5,714,766). Specifically, the Examiner stated:

4. Claims 1-5 are rejected under 35 U.S.C. 102(b) as being anticipated by Chen et al. (US 5,714,766).

With respect to claim 1, Chen et al. teach a vertical tunneling transistor, comprising (see fig. 6 and associated text):

a channel 26 disposed on a substrate 20;

a quantum dot 34, 34', or 34'' disposed so that the channel is between the quantum dot and the substrate;

a gate 16 is disposed so that the quantum dot is between the gate and the channel; and

wherein an axis through the channel, quantum dot, and the gate is substantially perpendicular to an upper surface of the substrate.

With respect to claim 2, Chen et al. further teach a source 18 disposed on the substrate adjacent to the channel. See fig. 6 and associated text.

With respect to claim 3, Chen et al. further teach a drain 14 disposed on the substrate adjacent to the channel. See fig. 6 and associated text.

With respect to claim 4, Chen et al. further teach a tunneling barrier 30, 30', or 30'' disposed between the channel and the quantum dot. See fig. 6 and associated text.

With respect to claim 5, Chen et al. further teach an insulative layer 38 disposed between the quantum dot and the gate. See fig. 6 and associated text.

5. Claims 26, 27, 28, 29, 30, 31, 32, 33, 34, and 35 are rejected under 35 U.S.C. 102(b) as being anticipated by Chen et al. (US 5,714,766).

With respect to claim 26, Chen et al. teach a vertical tunneling transistor, comprising (see fig. 6 and associated text):

a channel 26 disposed on a substrate 20;

a quantum dot 34,34', or 34'' disposed so that an axis through the channel and the quantum dot is substantially perpendicular to the substrate; and a gate 16 is disposed so that an axis through the channel, the quantum dot, and the gate is substantially perpendicular to the substrate.

With respect to claims 27, 28, 29, 33, and 35, it is noted that the recited process limitations are not given weight in the patentability determination of present device claims.

With respect to claim 30, Chen et al. further teach a source 18 disposed adjacent to the channel. See fig. 6 and associated text.

With respect to claim 31, Chen et al. further teach a drain 14 disposed adjacent to the channel. See fig. 6 and associated text.

With respect to claim 32, Chen et al. further teach a tunneling barrier 30,30',30''. See fig. 6 and associated text.

With respect to claim 34, Chen et al. further teach an insulative layer 38. See fig. 6 and associated text.

Office Action, pages 3-4.

### ***Legal Precedent***

Anticipation under section 102 can be found only if a single reference shows exactly what is claimed. *Titanium Metals Corp. v. Banner*, 778 F.2d 775, 227 U.S.P.Q. 773 (Fed. Cir. 1985). For a prior art reference to anticipate under section 102, every element of the claimed invention must be identically shown in a single reference. *In re Bond*, 910 F.2d 831, 15 U.S.P.Q.2d 1566 (Fed. Cir. 1990). To maintain a proper rejection under section 102, a single reference must teach

each and every limitation of the rejected claim. *Atlas Powder v. E.I. du Pont*, 750 F.2d 1569 (Fed. Cir. 1984). Accordingly, Applicants need only point to a single element not found in the cited reference to demonstrate that the cited reference fails to anticipate the claimed subject matter. The prior art reference also must show the *identical* invention “*in as complete detail as contained in the ... claim*” to support a *prima facie* case of anticipation. *Richardson v. Suzuki Motor Co.*, 868 F.2d 1226, 1236, 9 U.S.P.Q. 2d 1913, 1920 (Fed. Cir. 1989) (emphasis added).

### ***Deficiencies of the Rejection***

The Applicant traverses these rejections. Specifically, the Applicant respectfully asserts that several features of independent claims 1 and 26, as amended, are not disclosed by the Chen reference. For example, independent claim 1, as amended, recites a “vertical tunneling transistor, comprising...a quantum dot disposed so that the channel is between the quantum dot and the substrate, *wherein the quantum dot is comprised of at least one of tungsten, tin, platinum, or rhodium*. (Emphasis added). Similarly, independent claim 26 recites “disposing a quantum so that an axis channel and the quantum dot is substantially perpendicular to the substrate, *wherein the quantum dot is comprised of at least one of tungsten, tin, platinum, or rhodium*.” (Emphasis added). In sharp contrast, the Chen reference makes no mention of the above-recited claim features. In fact, the Chen reference does not even mention the words tungsten, tin, platinum, or rhodium. For this reason alone, the Chen reference cannot anticipate independent claims 1 or 26 and their dependent claims.

In addition to the missing features outlined above in regard to independent claims 1 and 26, the Applicant respectfully asserts that claims 4 and 32 are also allowable, because the Chen reference does not disclose a vertical tunneling transistor “comprising a tunneling barrier... *wherein the tunneling barrier comprises at least one of tantalum carbide or hafnium oxide,*” as recited in claim 4 or a method comprising “providing a tunneling barrier, *wherein the tunneling barrier comprises at least one of tantalum carbide or hafnium oxide,*” as recited in claim 32. (Emphasis added). The Chen reference clearly does not include the above-recited claim features. In fact, the Chen reference makes no mention of either “tantalum carbide or hafnium oxide,” as recited in claims 4 and 32. For this reason, in addition to the reasons set forth above with regard to claims 1 and 26, the Applicant respectfully asserts that dependent claims 4 and 32 are allowable over the cited references. As such, the Applicant respectfully requests withdrawal of the pending rejections and allowance of dependent claims 4 and 32.

#### **Claim Rejections under 35 U.S.C. § 103(a)**

The Examiner rejected claims 6-10 under 35 U.S.C. § 103(a) as obvious over Mullarkey (U.S. Patent No. 2002/0021158) in combination with Chen et al. (U.S. Patent No. 5,714,766). In particular, the Examiner stated:

7. Claims 6-10 are rejected under 35 U.S.C. 103(a) as being unpatentable over Mullarkey (US 2002/0021158) in combination with Chen et al. (US 5,714,766).

With respect to claim 6, Mullarkey teaches an integrated circuit device, comprising (see [0007]):  
a substrate of wafer 10;

a memory array that includes a plurality memory cells disposed on the substrate, each of the plurality of memory cells comprising a memory element and an access transistor.

However, Mullarkey fails teach that the access transistor is a transistor as recited in present claims 6-10. Chen et al. teach a transistor as recited in present claims 6-10. See the above rejection.

It would have been obvious to one of ordinary skill in the art of making semiconductor devices to use the transistor as taught in Chen et al. in the device of Mullarkey because the transistor of Chen et al. allows storage of multi-bit word. See col. 2, lines 35-38 of Chen et al.

Office Action, pages 4-5.

### ***Legal Precedent***

The burden of establishing a *prima facie* case of obviousness falls on the Examiner. *Ex parte Wolters and Kuypers*, 214 U.S.P.Q. 735 (PTO Bd. App. 1979). Obviousness cannot be established by combining the teachings of the prior art to produce the claimed invention absent some teaching or suggestion supporting the combination. *ACS Hospital Systems, Inc. v. Montefiore Hospital*, 732 F.2d 1572, 1577, 221 U.S.P.Q. 929, 933 (Fed. Cir. 1984). The mere fact that references can be combined or modified does not render the resultant combination obvious unless the prior art also suggests the desirability of the combination. *In re Mills*, 916 F.2d 680, 16 U.S.P.Q.2d. 1430 (Fed. Cir. 1990). Accordingly, to establish a *prima facie* case, the Examiner must not only show that the combination includes *all* of the claimed elements, but also a convincing line of reason as to why one of ordinary skill in the art would have found the claimed invention to have been obvious in light of the teachings of the references. *Ex parte Clapp*, 227 U.S.P.Q. 972 (B.P.A.I. 1985). ). The Examiner must provide *objective evidence*,

rather than subjective belief and unknown authority, of the requisite motivation or suggestion to combine or modify the cited references. *In re Lee*, 61 U.S.P.Q.2d. 1430 (Fed. Cir. 2002).

### ***Deficiencies of the Rejection***


The Applicant respectfully traverses these rejections. In particular, the Applicant asserts that several features of independent claim 6 are not disclosed by the cited references. For example, independent claim 6, as amended, recites “a memory array... comprising... a quantum dot disposed so that the channel is between the dot and the substrate, *wherein the quantum dot is comprised of at least one of tungsten, tin, platinum, or rhodium.*” (Emphasis added). In contrast, neither the Mullarkey reference nor the Chen reference discloses a quantum dot “comprised of at least one of tungsten, tin, platinum, or rhodium,” as recited in claim 6. In fact, neither the Mullarkey reference nor the Chen reference even includes the words tungsten, tin, platinum, or rhodium. For this reason alone, it is clear that the Mullarkey and Chen references, taken alone or in combination, fail to teach or suggest the above-recited features of independent claim 6. As such, the Applicant asserts that independent claim 6 and the claims that depend therefrom are patentable over the Mullarkey reference in light of the Chen reference.

### **Conclusion**

In view of the remarks and amendments set forth above, the Applicant respectfully requests allowance of the pending claims 1-10 and 26-35. If the Examiner believes that a telephonic interview will help speed this application toward issuance, the Examiner is invited to contact the undersigned at the telephone number listed below.

Respectfully submitted,

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Attachment: Replacement Drawing Sheet